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It is proposed to publish from time to time, as occasion may serve, Bulletins on subjects connected with Agriculture and Horticulture in the Malay Peninsula. It is hoped that planters will send to the Director of the Botanic Gardens, Singapore, notes and observations on the cultivation of the various crops under their care. Observations on insect and fungus-pests are especially requested, and these should always be accompanied by specimens of the injurious insect or fungi either alive, or preserved in spirits, except in the case of butterflies and moths, which should be sent dry in envelopes.

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REPORT

ON

DISEASES OF THE NUTMEG AND CLOVE TREES

IN

PENANG AND PROVINCE WELLESLEY.

A.—NUTMEGS.

1. I have found no less than nine direct causes of injury to the nutmeg tree, of which only one has yet produced serious damage, though the others may, under special circumstances, become productive of much evil. I propose to deal in this report with the important ones, leaving the less destructive pests to a Bulletin on the Cultivation of Spices, which I hope soon to publish.

2. *The Nutmeg Beetle.*—This is a very small insect belonging to the group of Hylesini (*Scolytidæ*), the various species of which are well known as among the most deadly enemies to trees. The beetle is only one-eighth of an inch long and often less. It is of a deep blackish brown colour, cylindrical in outline and quite blunt at both ends. Specimens have been sent to the British Museum for identification.

Like all of the group, it deposits its eggs beneath the bark of the tree, and the small white grub attacks the cambium layer—the living layer between the bark and the wood—eventually causing the bark to flake off.

Sometimes it attacks the branches of the tree burrowing at the base of each twig. In this case the twigs die on each bough beginning with the lowest. The leaves do not fall at first, and the appearance of boughs, in which the leaves on the lower twigs hang dead while the upper twigs are still alive indicates that the beetles are in these boughs. The Chinese say that when a tree loses its head it will recover, and consider the death of a few boughs unimportant. This is a serious mistake, as the beetles soon leave the dead twigs and commence to attack the base of the stem.

3. The nutmeg has a strong tap root, and the underground portion of the stem and tap root are the next parts to be attacked, and indeed this may occur in a neglected plantation when few or no branches on the tree show signs of damage. The destruction of the underground portion is unnoticed till the beetles work up above ground when the bark peels off and the wood is seen to be dead or dying beneath. The death of the tree thenceforward is

very rapid. As the beetles work away from the parts they have killed to fresh living parts, other beetles which feed on dead or dying wood, such as longicorns, attack the tree and complete the work of destruction. For some reason the beetles in attacking the base of the stem only attack on the side facing the greatest light. As nutmeg trees are usually planted on terraces made on the hills they are usually attacked on the face furthest from the slope behind them. So that the dying trees are seen to have the bark destroyed in a line up this face and all the boughs on that side are dying or dead.

4. There can be, I think, no doubt at all that, it was this beetle which, in 1860, nearly destroyed entirely the cultivation of the nutmeg in Penang and Singapore. The description of the catastrophe by Surgeon Collingwood, meagre as it is, seems clearly to point to the action of this beetle. No one seems to have hitherto discovered the cause, the beetle being quite overlooked. It was stated that trees attacked in the night were whithered at the top by morning, and I was also told that a tree would be killed in two or three days after it was attacked. These statements are probably due to want of observation, the attack at the base underground not being noticed till the living layer had been killed nearly all round the tree.

5. *Remedy.*—As now the owners of plantations at Bukit Mertajam and elsewhere are asking for abatement of assessment on the ground that the trees are dying, or abandoning the cultivation altogether, it becomes necessary to see what can be done to stay the plague.

It is absolutely essential that all branches attacked by the beetle should be at once burnt. The Chinese do not, as good cultivators would, cut off and destroy branches dead from any cause, but leave them lying in or under the trees. If a tree dies they leave it standing in the ground, and the beetles naturally fly to the next tree. If they do lop off the boughs they throw them on the ground or use them in place of stones to embank the newly planted trees. As I have found the beetle living six inches underground, burying the boughs, especially with their ends projecting, as is usually done, at the base of young trees, is merely bringing the beetles to the new plants as seems to be invariably the case in a plague of this kind, a few boughs are at first destroyed here and there and no notice is taken of it, the beetles increase in numbers, a few trees die, still no notice is taken, then almost suddenly the disease becomes virulent, every tree is more or less attacked; they rapidly die, and the owner abandons the plantation, leaving the trees to spread the infection.

To the owner of one plantation now almost ruined I showed the beetle and explained what had happened, urging him to burn all the dead branches and dying trees, one tree still bore one or two miserable nutmegs which could never be worth picking. "Do you mean that I am to burn that tree?" he said. As long as there

was one nutmeg on the tree he would not destroy it. Unfortunately, dying trees, as often happens in other kinds of trees, produce a quantity of fruit, so that they are preserved to the last, by the owner.

6. It is more difficult to prevent the beetles from attacking the base or subterranean portion, or to arrest the injury when commenced. I notice that the better class of cultivators are in the habit of covering the ground beneath the trees with cut *lalang*. This not only protects the roots from excessive heat and supplies some nourishment to the tree, but it also appeared to me that the beetles attacked these trees much less, perhaps they could not find their way to the bark so easily. Turfing round the trees up to the base of the stem would, I believe, have the same effect, but is not always practicable.

I would also suggest that cultivators should tar the base of the stem, or even tie brushes of coconut husk, which might also be tarred, around the base of the stem to the ground. But it must be remembered that the attack commences usually at least at the collar, *i. e.*, at the point where the tree projects above the ground so that the brush must be pressed right down to the ground.

7. The greatest difficulty will be to persuade the Chinese cultivator to take any steps at all against the pest, but this might be done through the well-known large cultivators who take pains with their plantations. To a good cultivator, the disease presents no real difficulty of eradication, and it is truly remarkable that in 1860 the nutmegs were allowed to die out under European management.

8. The rigorous destruction by fire of dead twigs, boughs and trees, the latter being dug out of the ground and burnt, or burnt *in situ*, will, I think, prevent the pest doing much damage, and might well be insisted on.

I would suggest that notices in Chinese, explaining briefly the cause of the injury and this remedy, should be supplied to the Chinese cultivators, that they may be able to check the disease for themselves. Perhaps some of the well-known insecticides, such as Paris green, might arrest the attacks even after they have well commenced, but I am unwilling to suggest any till I have experimented with them, as the nutmeg is rather a sensitive tree.

9. *Other Diseases. Mango-borer.*—The mango tree is very liable to injury from a boring caterpillar which burrows up the branches and kills them. It is not unusual to find mango trees planted in or near the nutmeg plantations, here and there, and it often happens that the moth which is produced by this caterpillar (which appears to be allied to the English leopard-moth) not finding sufficient mango trees to deposit its eggs on, attack the nutmegs with disastrous results.

As these mangoes produce few or no fruit, and those of bad quality, I would urge the destruction of these mango trees in and near the plantations.

10. *Mistletoes* (*Loranthus*).—These parasitic plants are most injurious to the trees, soon killing the boughs on which they fix themselves. The Chinese are aware of this and generally destroy the plant, but their constant habit is merely to break off the branches of the plant, leaving the roots still in the branch. The branch of the nutmeg in which the Loranthus is should be cut off a little below the plant, otherwise it will still go on doing harm.

11. Less important enemies which I have seen on the nutmeg are the common blight (a *Coccus*), a leaf mining caterpillar, a very beautiful silvery spangle-like scale, and gall insects, which covered the leaves of weak plants with orange coloured galls, entirely spoiling them. From the galls I bred two dipterous insects (*Cecidomyia*), and one hymenopteron, apparently a *Cynips*. None of these enemies appear to do much damage, chiefly attacking weak plants. Burning the infected leaves, would be the best remedy if necessary.

B.—WHITE NUTMEGS.

Some trees are said to produce only white nutmegs, that is to say, nutmegs in which when the husk splits the mace is seen to be white or only tinted with red, and the shell (*testa*) of the seed is pale or brown, the seed itself being quite soft inside. These nuts are quite useless.

On comparing some white nutmegs with normal ones I find that, besides the above-mentioned points, the embryo is much smaller, and in two cases I could not find it at all. I do not think there can be any doubt that the white nutmegs are fruits in which development has been arrested from want of, or insufficiency of fertilization.

The nutmeg tree is commonly unisexual, but trees often occur which bear both male and female flowers. It is the custom of the Chinese in Penang and Province Wellesley to destroy any trees which produce no fruit, consequently all the male trees are cut down and the whole of the fertilization depends on the male flowers in hermaphrodite trees. These are really insufficient for the purpose. I have seen plantations in which not a pure male tree could be found. In such places a large proportion of the female flowers must drop unfertilized and many more must be insufficiently fertilized and drop as white nutmegs.

I was shown spots on the husk of the white nutmegs which were supposed to be the cause of the phenomenon, but they appeared only to be spots of decay on which a mould was growing, and the decay had rarely penetrated deep enough to touch the mace, so I do not think this has anything to do with the production of white nutmegs. Cultivators should be warned of the folly of des-

troying male trees, which should be regularly tended. The Malacca planters are aware of the importance of the male trees, and though they do not manure them, they leave them to grow.

C.—DISEASE OF THE CLOVE TREE.

At Penara Bukit (Penang) I found a number of clove trees perishing from the attacks of a borer. This borer is a caterpillar of a moth which I hope soon to rear. It is black with yellow rings, about an inch and-a-half long and covered with rather sparse long hairs. The caterpillar usually bores into the branches, more rarely into the main stem, and tunnels up the centre, eventually killing the branch. Two or three may occur in one branch. The entrance to the burrow is protected by a web enclosing the small pellets or excreta.

The pest seemed very destructive, though the Chinese seemed to consider the loss of a few branches of little importance. In several trees they had cut the caterpillar out, evidently recognizing the nature of the plague.

Hacking the tree about in this way is, of course, very injurious. The best method of dealing with the animal would be to pass a thin wire up the hole into the burrow and so spear the caterpillar.

There is not much difficulty as to this, as the burrow is usually straight and not very long and is quite clear of the excreta, which, as previously mentioned, are ejected at the mouth of the hole. The smaller boughs affected should be cut off and burnt.

H. N. RIDLEY,
Director of Gardens and Forests.

Singapore, April 20th, 1896.